# North Pacific Fishery Management Council

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**Certified:** Stan Blendy
**Date:** 7/11/12

**REPORT**
**SCIENTIFIC AND STATISTICAL COMMITTEE**
**NORTH PACIFIC FISHERY MANAGEMENT COUNCIL**
**June 4th – June 6th, 2012**

The SSC met from June 4th through June 6th at the Kodiak Inn Harbor Room, Kodiak AK.

Members present were:

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| Pat Livingston, Chair<br>*NOAA Fisheries—AFSC* | Robert Clark, Vice Chair<br>*Alaska Department of Fish and Game* | Jennifer Burns<br>*University of Alaska Anchorage* |
| Henry Cheng<br>*Wash. Dept. of Fish and Wildlife* | Alison Dauble<br>*Oregon Dept. of Fish and Wildlife* | Sherri Dressel<br>*Alaska Department of Fish and Game* |
| Anne Hollowed<br>*NOAA Fisheries—AFSC* | George Hunt<br>*University of Washington* | Gordon Kruse<br>*University of Alaska Fairbanks* |
| Kathy Kuletz<br>*US Fish and Wildlife Service* | Seth Macinko<br>*University of Rhode Island* | Franz Mueter<br>*University of Alaska Fairbanks* |
| Jim Murphy<br>*University of Alaska Anchorage* | Lew Queirolo<br>*NOAA Fisheries—Alaska Region* | Terry Quinn<br>*University of Alaska Fairbanks* |
| Kate Reedy-Maschner<br>*Idaho State University Pocatello* | Farron Wallace<br>*NOAA Fisheries—AFSC* | |

Members absent were:

Ray Webster
*International Pacific Halibut Commission*

**B-1(c) Advanced Notice of Proposed Rulemaking – revision to National Standard 1 Guidelines**

Grant Thompson (NMFS-AFSC) presented this issue. An Advanced Notice of Proposed Rulemaking (ANPR) was published on May 3, 2012, to request comments on potential revisions to the National Standard 1 Guidelines. Comments are due 90 days after publication. Dr. Thompson effectively summarized previous comments by the SSC on earlier NS1 guidelines, reviewed the extent to which these comments were addressed in the revised NS1 guidelines of January 16, 2009 (74 FR 3178), presented relevant recommendations from a Joint Plan Team working group on Total Catch Accounting (TCA), and highlighted several issues that he thought needed attention. The ANPR is wide-ranging in scope and lists 11 topics that have been identified for possible revisions. In addition, NMFS welcomes any other suggestions that would improve the NS1 Guidelines. Public testimony was provided by Merrick Burden (Marine Conservation Alliance) and Arni Thomson (Alaska Crab Coalition).

**Because of the broad scope of this action, the SSC plans to convene a working group made up of a subgroup of SSC and Plan Team members that will review the issues listed below, identify any additional issues for consideration, and provide more detailed comments to the Council for consideration.**

The ANPR lists the following topics related to NS 1 that NMFS is seeking comments on:

1. Stocks in a fishery
2. Overfishing and multi-year impacts
3. Annual catch limits and optimum yield
4. Mixed-stock fisheries and optimum yield
5. Scientific uncertainty and management uncertainty
6. Data poor stocks
7. ABC control rules
8. Catch accounting
9. Accountability measures
10. ACL exceptions
11. Rebuilding progress and revising rebuilding plans.

Previous comments provided by the SSC raised a number of issues and concerns that were not resolved in the current guidelines, including the following:

1. *Guidelines should be simplified considerably with respect to OFL, ABC, TAC, ACL, etc.* NMFS responded that its language was as simple as possible. Given that the ACL rule has been implemented according to those provisions in the guidelines, the SSC does not wish to reconsider this issue. (Topic #3)
2. *Does SSC advice on "achieving rebuilding targets" occur once or every year?* (Topic 11)
3. *Avoid requiring stocks to be included in multiple FMPs.* (Topic 1)
4. *Further guidance on state-delegated fisheries should be provided.* (New topic)
5. *The document all but rules out using a decision-theoretic approach or other approaches to deal with risk and uncertainty that are not codified in the guidelines.* The need to revisit the treatment of risk and uncertainty in the current guidelines was also highlighted in public comment (Topic 5).

Dr. Thompson informed the SSC that a Joint Plan Team working group on TCA has discussed several outstanding issues that are specific to catch accounting in the Alaska region, but may benefit from additional guidance in the NS1 revisions (Topic # 8 'Catch accounting' in the ANPR). These outstanding issues revolve around the treatment of 'other' catches (e.g., research catches, catches from experimental fishing permits) in assessment and management, specifically the need to distinguish between simply listing catches, using those catches in the estimation of reference fishing mortalities ($F_{40\%}$, $F_{35\%}$, etc.), using those catches to calculate harvest amounts (maxABC, OFL, etc.) based on the estimated reference Fs, and including those catches in the total catch for comparisons against the TAC. Guidance on specific methods for including 'other' catches in the estimation of reference points and for dealing with incomplete time series of historical catches in doing so may also be needed.

Other issues identified in the staff presentation:

- With regard to Topic #1 ("Stocks in the Fishery"), the guidelines should clarify that the MSFCMA requires fishing to be regulated such that the *entire marine ecosystem* is protected, and that regulation is not limited to the fishery's impacts on stocks that are either "in the fishery" or in the ecosystem component.
- With regard to data-poor stocks (Topic #6), the guidelines should emphasize that some stocks are data-poor because there is no fishery that warrants federal management. Perhaps these stocks should be removed from the FMP rather than guessing at appropriate values for the management quantities that would be required to manage a fishery if one actually existed.

- The guidelines should clarify that FMPs necessarily contain a variety of accountability measures (Topic #9), and avoid giving the impression that the only accountability required is to prevent ACLs from being exceeded or to correct or mitigate overages of the ACL, if they occur.

Several other issues for consideration were identified in SSC discussions:

- The SSC is concerned that economic considerations (e.g., a focus on "maximum economic yield" or profit maximization), may dominate social and ecological considerations in the specification of TACs and OY (topic #3 in the ANPR). While fishery economic performance is of legitimate interest, it may conflict with competing objectives, needs, and purposes provided for under OY. The guidelines should emphasize that all three dimensions (economic, social, and ecological need to be considered and, in particular, should provide additional guidance on how to account for the social effects of management actions on impacted communities.
- Several SSC members and members of the public noted the need for additional clarification of the concepts of risk and uncertainty and how to account for scientific and management uncertainty (Topic # 5).
- Additional guidance on rebuilding time lines and evaluating rebuilding progress for stocks whose growth may be limited by life history constraints or environmental factors are needed (Topic # 11). The Pribilof Islands blue king crab was cited as one example of this problem.

The working group will review each of the above issues to provide more specific suggestions and may identify additional issues that may help clarify the NS1 guidelines. Draft recommendations will be distributed electronically to the SSC for review and then be provided to the Council for consideration.

**C-2 Initial review HAPC-Skate egg concentration sites**

Sarah Melton (NPFMC) and David Witherell (NPFMC) provided an overview of an initial review draft EA/RIR/IRFA that describes action alternatives to identify, or identify and protect, up to six HAPC sites of skate egg concentrations in the Bering Sea. Public comment was provided by John Gauvin (Alaska Seafood Cooperative).

The SSC reviewed earlier versions of the initial review draft of this document in February and April 2012 and recommended that the document be returned to staff for additional work. The SSC recognizes the considerable work and resulting improvement in the document since it was last reviewed. **The SSC recommends that the document be released for public review after the following changes to the EA and RIR/IRFA portions of the document have been made.**

In response to our April 2012 comments on the EA, the authors provided clarification on the effects of fishing on the benthic habitat at egg concentration sites, methodology used to estimate the potential number of sites, information on the persistence of egg concentration sites over time, the distinction between information derived from research trawls and standard survey trawls or commercial trawls, and updated the descriptions of gear types and effects on bottom habitat. The SSC requests that the following items be addressed in the EA, prior to release of the document:

- On page 24-25 of the EA, there needs to be clarification on the concentration threshold used to determine the size of the HAPC sites. In particular, clarify the use of the 1,000 eggs/km$^2$ versus 10,000 eggs/km$^2$ thresholds in determining the size of the site throughout the EA.
- The total number of potential sites calculated and at the bottom of Table 6 (page 21 of the EA) represents a potential overestimate of the total number of sites, due to double counting of sites with multiple species present. A better estimate of the potential total number of sites is the difference in number of potential sites per species and the number of sites containing those species, summed across species and then added to the total number of known sites (6). This results in 13 to14 potential total sites, not 16 to19 sites.

- Provide more detailed information to support the statement describing the persistence of egg concentration sites over time.
- The document would also benefit from a careful review to fix numerous typos.

This is the third iteration of this draft RIR/IRFA that the SSC has evaluated. The RIR section reflects a very much improved economic impact analysis. The analysts have, by-in-large, been responsive to earlier SSC comments, suggestions, and concerns as these pertained to the RIR. The SSC would, nonetheless, recommend the analysts address the following concerns, to the extent practicable, before release for public review. In several places, the RIR incorrectly confounds the concepts of "harvest" and "value". For example, on page 85, paragraph 2, the text reports, *"Testimony further suggested that the impacts on the maximum potential **gross** foregone harvest ..."* or, in the fourth paragraph, where it is reported that *"... option c) would result in a maximum foregone **catch** of approximately $1,599,000 per year."* [emphasis added]. In the first example, the analytical technique is treating "at-risk" catch amounts which, by definition, implies 'gross' foregone harvest (i.e., no offsetting catches made in alternative open areas). In the second example, it is the gross economic value of $1.6 million that is identified, not the catch-amount. Several such misapplications have been identified in our review, and will be forwarded to the analysts for their consideration, along with some additional editorial recommendations.

In section 3.7.1.4 of the RIR, there needs to be an explanation as to why the effect on the fleet of moving to different areas was not presented in the analysis (i.e., due to the small amount of effort displaced).

Our review of the RIR also raised a question at section 4.5 Effects on Management, Monitoring, and Enforcement. The evaluation reflects the reported difficulty the USCG and OLE may have in verifying compliance with "gear-type" mandates and limitations within the subject skate egg HAPC areas. The specific concern cited pertains to distinguishing bottom-trawl gear from pelagic-trawl gear, given that the majority of monitoring and enforcement is anticipated to be accomplished through aerial over-flights of individual fishing operations. The assertion is made that, except in the fortuitous case of a USCG over-flight of a trawler while the terminal gear is on the stern ramp, it would be impossible to differentiate between, much less enforce a ban on only one of the two, trawl gear configurations. While this certainly appears to be factual on its face, it largely ignores the critical fact that 100% observer coverage aboard all trawlers active in the groundfish fisheries in these areas would represent a significant disincentive for use of illegal trawl gear. While referenced in passing in the final paragraph on page 89, the deterrent effect of having a fishery observer physically present on the deck at haul-back, seems to merit more discussion under this subject heading. The SSC recognizes fishery observers are not enforcement agents and should not be placed in that role. Nonetheless, it seems reasonable that an observer's mere presence during the setting and retrieving of the trawl gear, given the very obvious physical differences between bottom and pelagic configurations, could be a compelling and effective deterrent to potential violators. A more considered examination of the 'risk' of detection incurred by a would-be violator of a trawl-type restriction might alter the relative advantage of alternatives that contemplate banning one, as opposed to both, trawl configurations in the proposed HAPC areas.

Finally, for the RIR, the Net Benefit to the Nation summary asserts that *"... the overall net benefit to the Nation would not be expected to change to an identifiable degree ..."*. This conclusion appears to be excessively pessimistic. It seems reasonable to conclude, given the EFH Habitat Area of Particular Concern status motivating this Council action, that each of the action alternatives and options would increase the net benefit to the Nation, when contrasted to the Status Quo.

With these observations, and the minor editorial recommendations referenced earlier, the SSC finds the RIR to be a complete and well reasoned analysis of the range of economic and operational outcomes that may accompany adoption of each of the competing HAPC Skate Egg action alternatives.

The IRFA, however, is deficient. Presently, the draft IRFA contains substantive errors, conflicting assertions, and incomplete treatment of required RFA elements. While recognizing that a fully compliant IRFA necessarily relies upon a declaration by the Council of a final "preferred alternative" (PA), the shortcomings of this draft extend beyond the PA considerations. The SSC encourages the analysts to reexamine the IRFA, especially sections 5.6 and 5.9. Inconsistencies are apparent in the treatment and interpretation of the entity size criteria, leading to contradictory and erroneous assertions concerning the number of directly regulated small entities to which the action may apply, as well as the nature and distribution of any attributable adverse economic effects. We believe the draft IRFA must be revised and corrected before the package is released for public review.

**C-3(a) Crab Plan Team Report, Set Catch Specifications for 4 stocks**

At this meeting, the SSC is providing the OFL/ABC recommendations for four crab stocks (Table 1). We also provide modeling advice for Tanner crab and St. Matthew Island blue king crab and recommendations on a variety of other issues. Diana Stram (NPFMC) and Bob Foy (NMFS-Kodiak) presented Crab Plan Team (CPT) recommendations for these four stocks, model reviews, and CPT discussions on a variety of other issues. Public testimony was provided by Linda Kozak (Golden King Crab Harvesters) and John Gauvin (Alaska Seafood Cooperative).

EBS Tanner Crab

Lou Rugolo (NMFS-AFSC) and Jack Turnock (NMFS-AFSC) presented an updated version of the Tanner crab stock assessment model. This model incorporates many of the recommendations made during the CPT meeting in May 2011, the SSC June and October 2011 meetings, the January 2012 modeling workshop and finally the CPT meeting in May 2012. During this time period, the model, data inputs, and model software have been updated numerous times. The SSC would like to express gratitude to the CPT, workshop participants and the assessment authors who have been responsive to requests for changes in model structure and update of data inputs.

The current base model incorporates: 1) two survey selectivity time periods, 2) an additional natural mortality term during the period between 1980 and 1984, 3) rescaled multinomial N values, 4) a revised method for estimating unobserved Tanner crab bycatch in the snow crab and BBRKC fisheries, and 5) a reduction in the fishing mortality penalty from 10 to 1 on the total likelihood. The CPT requested that the authors complete a number of analytical tasks to address a list of issues that should be completed prior to the September CPT meeting, and **the SSC agrees.**

Although a number of issues were identified in the current assessment, the CPT found the model adequately fitted the data sources and was sufficient to describe population dynamics of Tanner crab. The CPT agreed that adequate information was available on maturity and selectivity for the stock to be placed in Tier 3. **The SSC agrees with the CPT and recommends that the model be accepted to manage Tanner crab as a Tier 3 stock.**

Having accepted the Tanner crab model, the CPT also recommended that this Tanner crab model be used to make projections for the rebuilding analysis. Model projections estimate the yield- (catch)-per-recruit, and analysts must identify the level of recruitment (mean recruitment over a specified time-period) that scales the estimate to a measure of absolute abundance. The CPT recommended that the assessment authors bring forward $B_{MSYproxy}$ estimates in September 2012 that are derived by averaging recruitment for a broad range of alternative $B_{35\%}$ definitions. The authors are also allowed to recommend any other subset of mean model year recruitments, so long as they provide justification based on agreed-upon CPT protocols. **The SSC agrees with these CPT recommendations and recommends that the authors bring forward several plausible models using various recruitment time series including a scenario that includes all years with reasonably estimated recruitment.** In addition, the authors should consider a rebuilding alternative that mimics the state harvest policy in the east and west.

Pribilof Islands Blue King Crab

In response to an SSC request, information was presented on the distribution of blue king crabs in the annual trawl survey and PSC in commercial fisheries, size/sex composition of the catch, and actual numbers of blue king crabs observed as PSC compared to extrapolated estimates of total blue king crab PSC. Unfortunately, the new information did not clarify the Pribilof Islands blue king crab stock boundary issue. The problem is that the current blue king crab distribution is not confined to the vicinity of the Pribilof Islands. Instead, blue king crabs are more broadly distributed away from the Pribilof Islands, including into Bristol Bay. Blue king crabs off St. Matthew Island are managed as a separate stock, and blue king crabs also occur off Nunivak Island and in Port Heiden. Thus, the stock assignments of crabs from Bristol Bay are highly uncertain. The CPT considered this issue in May 2012, and concluded that the current boundaries do not adequately describe the Pribilof Islands blue king crab stock, but they were unable to reach a definitive recommendation about specific changes to the boundary. Given these uncertainties, the SSC struggled with this issue, as did the CPT. **As the NMFS trawl survey consistently finds blue king crabs in stations 20 nm east of the Pribilof District, the SSC recommends, as an interim measure, moving the effective stock boundary 20 nm to the east for management purposes.** The following research would help inform this issue: (1) tagging studies to investigate potential movement of blue king crabs from the Pribilof Islands to Bristol Bay and vice versa, (2) collection of crab size measurements of blue king crabs taken as PSC, to understand whether these crabs represent juvenile settlement after larval drift or if instead they represent adult movements, and (3) insights about larval advection by ocean currents, gained from a Regional Ocean Modeling System (ROMS).

St. Matthew Island Blue King Crab

The St. Matthew Island blue king crab fishery had been managed under Tier 4 using a four-stage catch-survey analysis (CSA). However, some issues with the model emerged in 2010 and 2011, raised by the SSC, CPT, and during a crab modeling workshop in February 2011. While the model was being revised in response to these comments since 2010, the ABC and OFL for 2011 were instead calculated based on NMFS trawl survey estimates of mature male biomass and using a 10% buffer to account for uncertainty due to a mismatch between survey station distribution and the distribution of the crab stock. The assessment author has been developing a simpler three-stage CSA, which has undergone review by the CPT and SSC in the past year. The latest version was reviewed by the CPT at their May 2012 meeting and by the SSC at this Council meeting.

**The CPT recommended using the three-stage CSA for the fall 2012 fishery and the SSC concurs with this recommendation.** The assessment author has clearly described the model structure, data, parameters, and fitting procedure, including provision of the AD Model Builder code. The model fits the survey data reasonably well and residual fits to the three stage proportions are generally well behaved. The CPT has provided some very helpful recommendations to the assessment author, and the SSC supports these recommendations. In addition, the SSC offers the following comments and recommendations:

- Clarify that "recruits" corresponding to stage 1 are recruits to the model, not recruits to the fishery (page 2).
- In the section on model population dynamics, it is stated that the impact of groundfish fisheries on the stock are small. However, the survey-based methods document (Table 4) indicates that 300,000 lbs of blue king crab were caught in fixed gear in 2007/08, resulting in an estimated PSC mortality of 150,000 lbs. Please address this and explain whether the proposed approach adequately addresses such situations.
- On the bottom of page 3, please provide a little more explanation about the abundance index proportionality constants (Qs) and trawl or pot survey abundance indices (As). Are the Qs calculated as the abundance index for any one year divided by the largest abundance index in the

time series? Also, please explain the units for the As. For the trawl survey, are these total area-swept abundances or mean station densities? For the pot survey, do the As represent mean catch per pot?

- On the top of page 4, the stage mean weights are subscripted by year, suggesting that they are estimated annually. However, Table 5 indicates that the means for stage 1 and 2 are fixed and only the stage-3 mean weights are estimated annually. True stage-1 and -2 mean weights would vary by year depending on variability in year-class size and growth rates, so it should be mentioned that fixing these to constants is a simplifying assumption. Are data insufficient to reliably estimate these annually?
- The SSC appreciates the author's attempts to explore various weighting scenarios. As pots are designed to catch crab, one might expect to put a higher weight on the pot survey compared to the trawl survey. However, the trawl surveys are conducted annually and cover a wider area. Some additional explanation for the relative weights applied to pot and trawl surveys would be helpful.
- In eq. (3), stage 3 selectivity is set to unity and the selectivities of the other two stages are estimated in the model. However, the model estimates the trawl selectivity of stage 2 crab to be 1.24 (Table 6). It does not seem plausible that smaller crab (stage 2) would have a higher selectivity than larger crab (stage 3). The Crab Plan Team provided advice on this issue, which the SSC supports.
- The SSC appreciates the four alternative model scenarios that were considered. It would be more helpful if the alternative model fits were plotted with time series of survey estimates, as was done for the preferred model in Fig. 1. For viable alternatives, it would also be useful to plot residuals and other diagnostics, or using retrospective analysis to help confirm the model choice. The SSC is inclined to agree that it is best to estimate mortality for 1998/99, but remains interested in seeing a comparison of fits, as well as the diagnostics mentioned in the text.
- The SSC requests the assessment author work toward future development of both Tier 3 and 4 reference points for this stock, including a description of the quality of data used for each and the author's recommendation for choice of tier level.
- The SSC suggests estimating the natural mortalities corresponding to each size class. This can increase the understanding of the survival of this species directly and avoid confounding the effects of movement and growth on the natural mortality estimate. With the three known size classes, the mathematical symbols are $M_1$, $M_2$, and $M_3$ and they are independent from time $t$.
- The SSC suggests that the input data be corrected or adjusted for any bias due to the differences arising from data, index, or information collected at different time periods within a year.
- The authors might consider using the "universally optimal" concept from statistical experimental design to determine the weighting of each component of the likelihood. Universally optimal means the estimated variance-covariance matrix of the model is close to a completely symmetric matrix.
- The author might consider plotting the annual estimate of population size that is over the largest size class stated in the model.

Norton Sound Red King Crab

The CPT discussed a request from ADF&G staff to move the timing for specifications for the NSRKC stock to earlier in the year to allow additional time to set the GHL prior to the start of the CDQ portion of the fishery in late May. The author proposed three options:

1. Move the May CPT meeting to March and do specifications for all four stocks and model evaluations prior to the April Council meeting;
2. Have a one day CPT meeting (or possible teleconference) in March to discuss NSRKC only and make recommendations;
3. Set specifications for NSRKC in September, understanding that this would entail dropping data from the assessment, due to the time lag in acquiring the fishery-data.

The main concern is that CDQ fisheries could start in May, before TAC setting had been completed. SSC discussed the different options. The SSC suggested that the Council and ADF&G could also consider an option where preliminary TACs are specified for the upcoming year, which would be amended after the June Council meeting. The minutes of the CPT meeting include a discussion of the pros and cons of the three options. The SSC has deferred a recommendation on moving the specification timing until after the CPT provides their preferred option for next year's ABC/OFL setting.

The 2012 NSRKC assessment addressed the SSC concerns regarding retrospective patterns. The author introduced twelve models for consideration by the CPT. The author's preferred model introduces a high natural mortality on the largest size bin (M=0.648), increases the weight on the commercial CPUE, and reduces the maximum effective sample sizes. The SSC has examined the relative fits of the 12 models, and agrees with the CPT that there are several troublesome issues with the current model including:

- A lack of bycatch data. The CPT requests that some data on bycatch be collected in conjunction with the recently funded NPRB project.
- Length composition data have been downweighted, but there still is apparent conflict within the model. This is a possible indication of model mis-specification.
- A need for better biological justification for the higher natural mortality on animals in the largest length bin (none of the models address dome vs. asymptotic M).
- The recommended model does not fit early data.

The SSC requests that the author carefully consider these issues when preparing for the CPT modeling workshop that will be held in January 2013. In addition, the SSC notes that the current model assumes that selectivity of the trawl survey follows a sigmoid function and Q was estimated 1.0 for length classes 3 through 5. The SSC asks the author to review this assumption given the results of recent studies of trawl survey Q for Bristol Bay red king crab, snow crab and Tanner crab.

The SSC accepted the CPT recommendation that Model 12 be used for OFL and ABC specification. The SSC supports the recommendation that the NSRKC assessment model be reviewed at the January 2013 modeling workshop, particularly in light of requests to set specifications for this stock out of the current sequence in the future. The SSC observed that the current model produces a slightly more conservative estimate of MMB than previous models.

**Based on this review, the SSC supports the CPT recommendations that the 2012/13 OFL be set at 0.24 kt and, given the uncertainty with this model noted above, a 10% buffer for the ABC which results in a recommendation of 0.22 kt.** The stock is above the MSST and thus the stock is not overfished. The total catch in 2011/2012 did not exceed the OFL and thus overfishing has not occurred.

Aleutian Islands Golden King Crab

The directed fishery on this stock has been prosecuted annually since the 1981-1982 season. There are no biomass estimates, accepted stock assessment model, or comprehensive annual surveys available for this stock. Therefore, the Aleutian Islands golden king crab fishery is managed as a Tier 5 stock.

The OFL calculation incorporates the average ratio of PSC mortality from groundfish fisheries. In previous assessments this has been based on data collected over the 1985/86 through 2008/09 seasons. The authors recommended an alternative (Alt.2) for calculating the PSC mortality rate based on four years of data collected during the 1985/86 through 1995/96 fishing seasons. The CPT agreed with the author's recommendation. The rationale is that PSC mortality during this time frame is a better reflection of PSC mortality in the current fishery. The SSC concurs with the author's and CPT's recommendations.

Based on this approach, **the SSC agrees with the CPT recommendation that this stock continue to be managed using Tier 5 allowing a total catch OFL of 5.69 kt and ABC of 5.12 kt for 2012/2013. The ABC is based on the ABC control rule which specifies a 10% buffer between the OFL and ABC.**

The CPT received a comprehensive review of the sources of catch, catch-rate, and length-frequency data used in the Aleutian Islands golden king crab model. Pot sample data are collected by observers deployed on fishing vessels and retained catch is recorded on fish tickets. Analysts found that there was general agreement between the CPUE estimated from the pot sample data and the CPUE estimated from the fish ticket data. It is the intent of the analysts that these data be incorporated into the AIGKC model and treatments of these data are important to minimize any potential bias in the index.

Much of the SSC discussion was focused on treatment of the data and modeling aspects of the CPUE data. The SSC has the following recommendations for the analysts:

- Use bootstrapping or 'canned' software for the delta-lognormal or similar distributions (Zeileis, A., C. Kleiber and S. Jackman 2008. "Regression Models for Count Data in R." *Journal of Statistical Software*, **27**(8). URL http://www.jstatsoft.org/v27/i08/.) to estimate the statistical inference of annual CPUE or index.
- Investigate interactions among factors in the CPUE standardization (seasonally, different vessels, etc.).
- Examine potential post-rationalization correlation between gear and soak time
- Examine changes in seasonality and fishery distribution pre- and post-rationalization
- Provide plots of length frequency data and spatial location of harvest over time to consider changes in harvesting effort and possible issues arising from distributional changes.

Pribilof Islands Golden King Crab

The Pribilof Islands golden king crab fishery has supported a small and sporadic fishery that is concentrated in the Pribilof Canyon region. There was no fishing effort between 2006 and 2009 and only one or two vessels fished in 2010 and 2011 (and in 2012 to date). There is no state harvest strategy in regulation for this fishery and the GHL has been established at 0.15 million pounds (68 t) since 2000. This stock has been managed using Tier 5 with a retained catch OFL for 2009 and 2010 based on average catches during the 1993 through 1998 time period. This short period was chosen because it encompasses the longest continuous time period during which vessels participated in the fishery and during which retained catch data are available and not constrained by a GHL. In last year's assessment, the author recommended, and the SSC accepted, a total catch OFL that is based on the average of the retained catches in 1993 through 1998, an estimate of bycatch rates in the directed fishery during 2001 through 2010, and average bycatch mortalities in the non-target crab fisheries and PSC in the groundfish fishery during 1994 through 1998 and 1992/93 through 1998/99, respectively.

Last year, the CPT and the SSC encouraged the author to explore the use of the eastern Bering Sea slope survey for purposes of moving the stock to Tier 4. The author presented area-swept estimates of biomass for the area of the fishery (Pribilof Canyon) and for the whole EBS slope survey region (200-1200 m depth), as well as the size composition of male and female crab from the 2004, 2008, and 2010 surveys. However, no Tier 4 calculations were presented.

**Following the advice of the assessment author and CPT, the SSC recommends a total catch OFL of 0.09 kt (91 t) and ABC (using the 10% buffer for tier-5 stocks) of 0.08 kt (82 t) for 2012/2013**, based on Alternative 1 in the assessment, which uses bycatch data for the directed fishery through 2010 only.

**For the next assessment cycle, the SSC requests that the slope survey data be used to bring forward Tier 4 calculations** because biomass estimates from the slope survey appear reasonable, cover the known

depth range of golden king crab, and size composition data are available to calculate biomass of legal-sized males.

The SSC also notes that the assessment uses calendar year for all calculations except for PSC in the groundfish fisheries, which are estimated based on "crab fishing years". For consistency, the SSC suggests that calendar year be used throughout.

Adak Red King Crab

The SSC reviewed the 2012 SAFE chapter for Adak red king crab (RKC). There is no assessment model for this stock. The fishery has had limited openings since 1995/96 and was closed for the 2011/12 season. **The CPT recommended and the SSC agrees that this stock should be managed as a Tier 5 stock.** The SSC agrees that the OFL should be estimated as average total catch, using the same base period as recommended last year (1995/96 through 2007/08). Based on this designation, the **SSC agrees with the CPT recommendation that the OFL for 2012/13 be set at 0.05 kt (56 t).**

The minimal data available suggest that the Adak RKC stock continues to be at a very low stock size. Evidence to support this conclusion includes: (1) the retained catch declined to low levels in the mid 1970s and has remained at a low level, (2) the last ADF&G Industry Survey was in 2002 and it provided no evidence of populations of sufficient size to support a directed fishery, (3) a pot survey was conducted in 2006 and it provided no evidence of recruitment, (4) the trawl survey of Petrel Bank in 2009 found a small aging population with no expected recruitment, and (5) ADF&G approved a test fishery in 2009 and this yielded a single mature male crab.

The SSC agrees with the CPT recommendation that the directed fishery for Adak RKC should remain closed and that the ABC should be based on an amount sufficient to address bycatch and PSC in other fisheries. The maximum permissible ABC is 48.99 t, based on the 10% Tier-5 buffer. The CPT recommended an ABC of 33.57 t based on the maximum level of bycatch observed during the reference period 1995/96 through 2007/08. However, the SSC continues to disagree with the CPT's rationale for addressing bycatch needs in other crab and PSC in groundfish fisheries. In 2011, the SSC agreed that the Council should include an allowance for incidental capture of Adak RKC in non-directed fisheries. Review of the time series of bycatch and PSC shows an allowance based on the mean bycatch for the period 1995/96 through 2007/08 should be sufficient.

This year, the SSC also considered the amount of Adak RKC needed to prosecute a test fishery. The CPT reported that industry has expressed an interest in conducting a test fishery around the Adak area. ADF&G estimated that 20 t would be needed to prosecute this test fishery. The SSC continues to be concerned about the paucity of data for Adak RKC and places a high priority on the collection of data for this stock. **Therefore, the SSC recommends an ABC of 0.03 kt (34 t) for 2012/13 (the CPT's recommendation). This amount should be sufficient to allow for bycatch and PSC in non-directed fisheries and the proposed test fishery catch.**

Crab PSC in the BSAI Groundfish Fisheries

The CPT considered a Council motion C-2(c) titled "Crab bycatch in the BSAI groundfish fisheries" from the June 2010 Council meeting. The Crab Plan Team recommended retaining Alternative 3 only, because it provides for accountability of crab PSC in the groundfish fishery, and varies PSC limits with crab abundance, thus scaling this conservation measure with the conservation need. The CPT provided a number of constructive comments and the SSC supports their advice on this topic.

Table 1. SSC OFL and ABC recommendations for four crab stocks on June 4th, 2012. Bold indicates where SSC recommendations differ from Crab Plan Team recommendations. (Note diagonal fill indicated parameters not applicable for that tier level while shaded sections are to be filled out for the final SAFE in September 2012)

| Chapter | Stock | Tier | Status (a,b,c) | $F_{OFL}$ | $B_{MSY}$ or $B_{MSYproxy}$ (kt) | Years[1] (biomass or catch) | 2012[2][3] MMB (kt) | 2012 MMB / $MMB_{MSY}$ | $\gamma$ | Mortality (M) | 2012/13 OFL (kt) | 2012/13 ABC (kt) |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1 | EBS snow crab | 3 | | | | | | | | | | |
| 2 | BB red king crab | 3 | | | | | | | | | | |
| 3 | EBS Tanner crab | 4 | | | | | | | | | | |
| 4 | Pribilof Islands red king crab | 4 | | | | | | | | | | |
| 5 | Pribilof Islands blue king crab | 4 | | | | | | | | | | |
| 6 | St. Matthew Island blue king crab | 4 | | | | | | | | | | |
| 7 | Norton Sound red king crab | 4 | a | 0.18 | 1.59 | 1980-current [model estimate] | 1.93 | 1.2 | 1.0 | 0.18<br>0.68 (>123 mm) | 0.24 | 0.22 |
| 8 | AI golden king crab | 5 | | | | See intro chapter | | | | | 5.69 | 5.12 |
| 9 | Pribilof Island golden king crab | 5 | | | | See intro chapter | | | | | 0.09 | 0.08 |
| 10 | Adak red king crab | 5 | | | | 1995/96–2007/08 | | | | | 0.05 | 0.03 |

[1] For Tiers 3 and 4 where $B_{MSY}$ or $B_{MSYproxy}$ is estimable, the years refer to the time period over which the estimate is made. For Tier 5 stocks it is the years upon which the catch average for OFL is obtained.
[2] MMB as projected for 2/15/2013 at time of mating.
[3] Model mature biomass on 7/1/2012

**C-3(b) Final action Pribilof Is. Blue King Crab rebuilding**
The SSC received a presentation of the EA from Diana Stram (NPFMC) and Jennifer Mondragon (NMFS-AKR), and the RIR/IRFA from Scott Miller (NMFS-AKR). Heather McCarty (Central Bering Sea Fisherman's Association) and Arni Thomson (Alaska Crab Coalition) provided comments relevant to this agenda item under the B-1(c) National Standard 1 ANPR agenda item.

The SSC provided comments on the earlier drafts of the rebuilding plan for Pribilof Islands blue king crab stock and was asked at this meeting to provide further comments regarding analytical methods to evaluate the efficacy of the closure described in the current Primary Preferred Alternative (PPA).

In order to evaluate which fisheries have contributed to the PIBKC PSC in the PPA, the analysts used several databases, including: the NMFS Catch Accounting System for PSC estimates of PIBKC (area 513 only), the observer program database for actual observed (only) PSC of PIBKC, and fish tickets for documented recordings of PIBKC PSC. This information was used to estimate PIBKC PSC and perform retrospective spatial extrapolations of the directed catch. Re-projection of directed catch of the target fisheries was spatially limited to 50 nm outside the PPA area closure. The spatial redistribution of catch within the closure area was used to illustrate where the fishery may redistribute when the closure area goes in effect. **Although the re-projection analysis is heavily dependent upon a number of strong assumptions, the SSC recognizes that this approach is reasonable, given available data and information.** There remain two areas that warrant further clarification.

First, the re-projection analysis begins with the assumption that the fleet will be able to fully recover the catch and associated revenue-at-risk in areas outside of the proposed blue king crab habitat conservation zones. However, in some parts of the document, this assumption is described as a "result" or a "conclusion" of the analysis (e.g., page 61 "This analysis concludes that it is likely that some or all of the catch can be made up outside of the smallest proposed closure areas"). This is a circular argument. Because the re-projection analysis begins with the assumption that the catch can be recovered elsewhere, this cannot subsequently be described as a conclusion of the analysis. This should be clarified throughout the document. In general, assumptions associated with the re-projection method need to be better described.

Second, the SSC reiterates its concern about the use of gross revenue at risk as a proxy for economic impacts. If the aforementioned assumption that the fleet will be able to recover the catch elsewhere is valid, then the gross revenue impacts are likely to be negligible. The meaningful economic impacts are more likely to be manifested as an increase in costs. As the document correctly notes, since these cost data are unavailable, it is not possible to conduct a useful analysis of the true economic impacts of the proposed action. Also, there needs to be, at least, a qualitative evaluation of the possible outcomes of vessels not re-supplying at the Pribilof Islands, following adoption of the action alternative.

To be consistent with adopted NMFS terminology, the capture of blue king crab by groundfish fishing operations should be described throughout the document as Prohibited Species Catch (PSC), not bycatch. These forms of removal are not equivalent within the BSAI (and GOA) Groundfish FMP that governs this action. Also, the round weight equivalent value of groundfish is mischaracterized in the text. While the numerical values are unaffected, their interpretation is altered.

**C-5(b) Initial review of FLL vessel replacement (MLOA adjustment)**
The SSC received a presentation of the subject RIR/IRFA from Diana Evans (NPFMC). Public testimony was offered by Kenny Down, Freezer Longline Coalition.

The SSC commented on an initial review draft at the December 2011 meeting and recommended that the document not be released for public review. The SSC appreciates the efforts of staff to address the

comments provided and finds the document is much improved. There are still deficiencies in the document that need to be addressed before release to the public.

While in some respects, the document is much clearer with regard to the primary source of concern, which is MLOA restrictions and not vessel replacement, this improvement is confounded by numerous references to the status quo as an "impediment" to vessel replacement. This erroneous assertion appears multiple times in the document (e.g., pages vii, 24-25, 39-40). Vessels can be replaced under the status quo, and the SSC received public testimony that at least two new vessels are currently under construction in this fleet. The document should clarify that, although relaxing MLOA constraints under Alternatives 2 and 3 may accelerate the timing of vessel replacement, the status quo does not impede vessel replacement.

In reference to National Standard 4 (page 39), the document asserts that the proposed alternatives "are intended to promote conservation of the groundfish resources in the BSAI and GOA." This statement is not currently supported by the analysis.

While the document acknowledges the potential for fleet consolidation, the document would benefit from more discussion and analysis of the likely resulting impacts from consolidation, such as crew opportunities and effects on coastal communities, and the potential implications of increased harvesting capacity. Depending upon the level of consolidation expected from the alternatives, some discussion of the "excessive share" clause in NS 4 may be warranted. On page 40, during the discussion of National Standard 8, the document asserts that this action is "not expected" to have an adverse effect on coastal communities. There is little evidence provided in support of this assertion and, indeed, it appears that if the fleet is consolidated, it is possible that some communities may be affected.

Under the discussion of National Standard 9, the document asserts that replacement vessels could reduce bycatch and PSC. While this may be the case, the document would benefit from a brief discussion that supports this assertion.

On page 26, the document mentions anecdotal evidence that there is pressure to improve crew quarters. This is not relevant to the action at hand and should be removed from the document.

The claim (page 40) that "[t]he impacts on participants in the freezer longline groundfish fisheries in the BSAI, and participants in other fisheries, have been comprehensively evaluated" is unsupported.

The data for Table 3 are missing. Figure 1 is missing.

The first sentence in Section 3.3 (page 40) refers to the GOA when presumably the BSAI is intended.

Tables 10 and 13 indicate that sablefish harvests by the FLL fleet are noticeably declining, but no explanation is given. These sablefish catch estimates should be checked for consistency with those reported in the SAFE. Are the declines due to TAC reductions in the IFQ fishery or is there another explanation?

**The SSC recommends release of the draft document for public review after addressing the principal concerns identified by the SSC and resolving editorial problems.**

**D-1(e) Review and approve 5-year research priorities**

During the June 2012 SSC meeting, it became clear that a more orderly process of submitting and prioritizing proposals for research priorities is needed. The SSC received the Council's list of research priorities from June 2011 and research priority lists from three Plan Teams, a halibut workshop report, a stakeholder-based research plan for the Aleutians, and staff summaries of EFH and protected species research. The lists were in different formats and some were quite lengthy. Thus, the SSC did not have

time to fully consider all the lists and requested changes. In particular, we did not have sufficient time to review the research in the halibut workshop report and incorporate that into our priorities. We recommend that the BSAI/GOA Plan Teams consider the research recommended in that report and, as appropriate, incorporate those of merit into their research priorities list this fall. **The SSC provides its recommended list of research priorities to the Council in Appendix A,** which follows at the end of this June SSC report and will provide Council staff with a track changes and commented version of the list. **In addition, the SSC proposes the following be considered for adoption by the Council as policy for the submission of Research Priorities to the SSC.**

The SSC will consider research priorities for inclusion in the annual NPFMC list of Research Priorities from the Plan Teams and members of the SSC. The SSC prefers to have Plan Teams be the initial filter for research priorities that come to the SSC. Sometimes EFH, protected species, and other issues relevant to a particular FMP may not be fully considered by each Plan Team, but the SSC recommends that Plan Teams make a more concerted effort to do so. Research priority lists should be provided by the Plan Teams in their Plan Team report, ideally to be received by the SSC no later than two weeks prior to the Council meeting at which the Plan Team Report is presented. The proposed research priorities should be entered in "Track Changes" in the Council's list of Research Priorities, as "published" in the minutes of the previous year's June Council meeting. The SSC will update a working copy of the Research Priorities list at each meeting at which it receives a list of priorities from a Plan Team, and will provide the Council with the full revised list at the June NPFMC meeting.

The SSC suggests that the Council consider adopting a process of evaluating and organizing the list of proposed Research Priorities using an Excel file or relational database type of system, with research priorities submitted on an Excel-based form to collect information about the proposed priority. When such a system is operational, the proposed research would include information on the question or data need to be resolved, whether the priority is an immediate concern or an ongoing need, relative rank (high, medium, low) among all priorities submitted by that Plan Team, impact on decision making, and species or fishery affected. Separate worksheets or database tables could be established for each Plan Team, the SSC, and the Council.

**D-1(g) Pacific cod assessment models**

Grant Thompson (NMFS-AFSC, and Pacific cod stock assessment author) presented Plan Team recommendations for models to consider in the 2012 preliminary Pacific cod assessment. These recommendations were based on proposals by the senior assessment author, the Plan Teams, the SSC, and the public. Following the process established in recent years, all proposals were evaluated and suggestions were allocated to a set of requested models for the 2012 preliminary assessment.

*Eastern Bering Sea.* Four models were recommended by the joint Plan Teams for Eastern Bering Sea, as well as one additional model recommended by the senior author:

- Model 1: Last year's final model (model 3b)
- Model 2: Last year's final model with re-tuned catchability
- Model 3: Last year's final model with new fishery selectivity in 2008 or 2010
- Model 4: Last year's final model without age data
- In addition, the senior author recommends a model similar to one brought forward in last year's preliminary assessment that addresses many of the suggestions received from the Plan Teams, SSC, CIE reviewers, and the public.

The SSC agrees with the selection of last year's final model as the baseline and with the proposed suite of alternative models. However, we note that there are limited data to assess any effects resulting from the creation of longline cooperatives in 2010 on fishery selectivity (Model 3). **Hence, the SSC recommends evaluation of a change in fishery selectivity in 2008 (in response to Amendment 80), but no change**

**in 2010.** In addition, we note that stock assessment authors are free to develop and bring forward an alternative model or models in both the preliminary and final assessment. However, given the Plan Team's (and SSC's) reluctance in previous years to consider a new author-recommended model in the fall that incorporates a large number of potentially influential changes in a single model (for example changes in growth, selectivities, and catchability), the SSC encourages the authors to evaluate changes in one or a few structural elements at a time.

*Aleutian Islands.* The SSC agrees with the Plan Team recommendation that the author bring forward a preliminary model for the Aleutian Islands *if there is enough time.* The author noted the lack of age data for the Aleutians Pacific cod stock, and the SSC agrees that length data should be used for all years (including for any year with age data). Authors should consider age composition sample size needs for the assessment and request aging of current sample collections for next year's assessment.

*Gulf of Alaska.* As for the EBS, the SSC agrees with the choice of last year's final model (formerly model 3, new model 1) as the baseline model for the Gulf of Alaska and a second model (model 2) that re-tunes catchability to match the empirical estimates from Nichol et al. (2007).

Catchability of Pacific cod in the survey remains one of the major unresolved issues. The SSC looks forward to ongoing research that will use acoustic technology (DIDSON) and gear comparisons to assess the catchability of cod in the GOA and EBS trawl survey gear. **We encourage the authors to incorporate results from these studies in this year's assessment to the extent practicable. This would involve tuning Model 2 to new estimates of catchability should they become available in time.**

The SSC also noted that the process of vetting models through a workshop and the Plan Team seems to be working well and should be used as long as model proposals are received from the public.

**D-1(h) Receive report of the Recruitment Workshop**

Grant Thompson (NMFS-AFSC) presented a Phase 1 report about a workshop dealing with issues related to spawner-recruit relationships (SRRs) held in Seattle and via Webex in April 2012. Holding this workshop was an SSC recommendation that resulted from an SSC workshop on recruitment issues at its February 2012 meeting. Attendees included members from the groundfish and crab Plan Teams, SSC members, stock assessment scientists, and members of the public. A working group was formed to report on the workshop. A final report is planned for review by the groundfish Plan Teams in September 2012 and by the SSC in October 2012. The workshop was held in April in order to provide guidance to the crab Plan Team at its May meeting.

The Phase 1 report covers three main topics: (A) how to identify regime shifts, (B) how to establish objective and consistent criteria for excluding individual years from a time series of recruitment estimates, and (C) how to forecast recruitment with environmental forcing. Current practice for groundfish is to use recruitment estimates from 1977 and later. Current practice for crab is to establish time periods for recruitment estimates with consideration of regime shifts, as identified through examination of changes in life history characteristics of the species and ecosystem characteristics.

The Phase 1 report should be viewed as preliminary. For topic A, the report identifies six alternatives for determining regime shifts, several of which involve breakpoint analysis. The recommended method is to fix the productivity parameter in the SRR and allow the scale parameter to differ between regimes. The workgroup and the SSC noted that for most alternatives a decision theory approach could also be used.

For topic B, the report identifies five alternatives for establishing criteria to exclude specific recruitment year classes, several of which involved excluding the last X years or excluding years with high absolute

or relative coefficients of variation. The report recommends a default of excluding the three most recent year-class estimates.

For topic C, the report identifies two alternatives that address whether or not to use environmental forcing in forecasting recruitment. The report recommends that we recognize that current knowledge of environmental forcing is insufficient to use when forecasting recruitment.

At its May 2012 meeting, the Crab Plan Team considered the results from the Phase 1 report. With regard to topic A, the team will develop software for breakpoint analysis, so that methodology will be standardized and attempts will be made to identify environmental covariates. With regard to topic B, the effect of tier status and fishing history are two factors that will be considered when determining what years to exclude. As a default, the full time series will be used after excluding the last three years, unless there is compelling evidence for a change in productivity. With regard to topic C, the team will follow the report's preliminary recommendation not to incorporate environmental forcing when forecasting recruitment.

The SSC views the April workshop as a great success and thanks Dr. Thompson for his clear presentation. The SSC agrees that the recommendations made in the Phase 1 report should be viewed as preliminary until the report is finalized and it receives review by both the Crab and Groundfish Plan Teams. The SSC notes that environmental forcing need not express itself through regime shifts and urges researchers to also consider environmental events and relationships. The SSC requests thorough documentation of the breakpoint analysis and software, including assumptions and statistical methodology or modeling. The SSC would also like to see some discussion of how workshop recommendations affect determination of virgin (or unfished) biomass. The SSC also suggests that life history, length frequency distribution, and ecosystem considerations could be useful in refining recommendations about analyzing SRRs. The SSC suggested that the Plan Teams consider life history when selecting the years to exclude from the time series. The SSC anticipates that a deliberative process will be needed to finalize recommendations and so does not expect all recommendations to be implemented until 2013. The SSC looks forward to the final workshop report.

**Appendix A.**

**SSC's Five-Year Research Priorities: 2012 through 2016 (as proposed in June 2012)**

The Scientific and Statistical Committee (SSC) has identified priorities for research in the next 1 to 5 years as those activities that are the most important for the conservation and management of fisheries in the Gulf of Alaska, Aleutian Islands, eastern Bering Sea, and the Arctic. This listing of priorities has two purposes: 1) to meet the requirements of the revised Magnuson-Stevens Act for the Councils to identify research that is needed in the next 5 years, and 2) to provide guidance on research priorities to the research community and to funding agencies.

The research priorities are separated into two categories: **Immediate Concerns** and **Ongoing Needs. Immediate Concerns** include research activities that must be addressed to satisfy federal requirements and to meet pressing fishery management and ecosystem issues related to fishery management. Within these categories, the SSC has indicated those Research Priorities for which **Research is Underway.** These are Research Priorities for which NPRB grants have been awarded or for which it is known to the SSC that one or more other agencies have undertaken the recommended research. These priorities will remain on the list until the recommended research is complete and evaluated in terms of its meeting the Research Priority that had been listed. **Ongoing Needs** include research to advance the Council's fisheries management goals as defined in the Groundfish PSEIS, other strategic documents of the Council (i.e., FMPs, AI FEP, and EFH, crab, salmon PSC, and other EISs) and NMFS. **Ongoing Needs** include efforts on which the assessment models depend for their annual updates. For example, without the survey information, the annual process of setting ABCs and OFLs for the managed stocks would be compromised. The Council sees these efforts as needed on an ongoing basis, and constituting the time series on which management is based. It should be recognized that research in these categories is being conducted or may be conducted through Federal, State of Alaska, North Pacific Research Board, and other funding sources.

**Five-Year Research Priorities: 2012-2016**

**Immediate Concerns**

I. Fisheries

A. Fish and Fisheries Monitoring

1. Non-recovering stocks. A pressing issue is why certain stocks have declined and failed to recover as anticipated (e.g., Pribilof Island blue king crab, Adak red king crab). Research into all life history components, including predation by groundfish on juvenile crab in near-shore areas, is needed to identify population bottlenecks, an aspect that is critically needed to develop and implement rebuilding plans.

2. Improvements are needed for catch accounting by sex and size for crab (genetic samples) in non-directed fisheries with high bycatch or PSCrates, particularly for blue king crab in the Pacific cod pot fishery in the Pribilof Islands.

3. Develop methods for reliable estimation of total removals (e.g., surveys, poorly observed fisheries) to meet requirements of total removals under ACLs. Improve species identification, by both processors and observers, for priority species within species complexes in catches. Methods that quantify and correct for misidentifications are desired.

4. There is a need to characterize the spatial distribution of male snow crab relative to reproductive output of females in the middle domain of the EBS shelf (partially underway)

B. Stock Assessment

1. Improve handling mortality rate estimates for crab and scallops. For crab, improved understanding on the post-release mortality rate of discarded crab from directed and non-directed crab pot fisheries and principal groundfish (trawl, pot, and hook and line) fisheries is required. The magnitude of post-release mortality is an essential parameter in the determination of total annual catch used to evaluate overfishing in stock assessment and projection modeling. For example, assess discard mortality rates of Tanner crab by size, month, sex, and fishery type. For scallops, conduct field studies to estimate scallop discard mortality (specifically the relationship between capture, release condition, and survival of scallops). (crab studies are partially underway: *Chionocetes* RAMP study)

2. Develop biomass indices for lowest tier species (Tier 5 for crab, Tier 6 for groundfish), such as sharks, and conduct net efficiency studies for spiny dogfish. Explore alternative methodologies for Tier 5 and 6 stocks, such as length-based methods or biomass dynamics models.

3. Owing to the lack of fishery-independent surveys for scallops, there is a need for analyses of fishery CPUE and observer data for use in assessing fishery performance and stock assessment. For instance, sharp declines in CPUE have occurred in some areas, such as Kayak Island and Alaska Peninsula, prompting concerns about local depletion. Additional new techniques may be desirable in regions with data-poor stocks.

4. New information and data are needed that would inform our understanding of the spawner - recruit relationship for groundfish and crab with sufficient precision to project year-class strength (e.g., Tanner crab, GOA pollock, sablefish, halibut). (Underway)

5. Conduct studies to determine stock structure and potential spatial management for BSAI pollock (e.g., movement).

6. Conduct district-wide surveys for demersal shelf rockfish in Southeast Alaska on an annual, biennial, or triennial basis.

7. Conduct a tagging study of red king crab in the region north of Bristol Bay to assess the movement between this region and the Bristol Bay registration area. Similar work on blue king crab in Bristol Bay relative to the Pribilof Islands is needed.

8. Research is needed on the vertical distribution of Pacific cod relative to the EBS bottom trawl and comparisons between the EBS and GOA trawl gear. (Underway).

9. Develop Pacific cod stock assessment for the Aleutian Islands region.

10. Tagging studies of Aleutian Islands Pacific cod and Atka mackerel are needed to create models of short-term movement of fish relative to critical habitat (tagging for Atka mackerel partly underway).

11. Studies are needed to validate and improve age determination methods for Pacific cod, Pacific sleeper sharks, and spiny dogfish. Conventional tagging studies of young of the year and/or one-year old Pacific cod would be useful in this regard (partially underway for cod and dogfish).

12. Maintain the core data from the eastern Bering Sea needed to support a diverse suite of models used to support the integrated ecosystem assessment program for the Bering Sea. Core data include inputs for single- or multi-species management strategy evaluations, food web, and coupled biophysical end-to-end ecosystem models (e.g. biophysical moorings, stomach data, zooplankton, age 0 surveys).

C. Fishery Management

1. Develop a research program that will facilitate evaluation of salmon (both Chinook and non-Chinook) PSC mitigation measures in the BSAI and GOA. This includes updated estimates of the amounts reasonably necessary for subsistence, timing of runs and openings relative to subsistence requirements, and access to cost data for the commercial pollock and salmon industries so that impacts on profits (not gross revenues) can be calculated.

2. Improve the resolution of Chinook and chum salmon genetic stock identification methods (e.g., baseline development, marker development), improve precision of salmon run size estimates in western Alaska, and initiate investigations of biotic and abiotic factors influencing natural mortality rate during ocean migration in the GOA and BSAI. (baseline development is nearing completion, more work on Cook Inlet Chinook and chums is needed)

3. Develop improved catch monitoring methods of fishery interactions including direct and alternative options (e.g., electronic logbooks, video monitoring), particularly on smaller groundfish, halibut, and commercially guided recreational fishing vessels, as well as an assessment of feasibility for small vessels. Investigate factors that affect angler demand in the guided angler sector of the halibut fishery resulting from regulatory changes or general economic conditions.(Underway)

4. Develop bioeconomic models with explicit age- or size-structured population dynamics for BSAI and GOA groundfish fisheries to estimate maximum economic yield and other bioeconomic reference points under uncertainty.

5. Research the benefits and costs of halibut and halibut PSC utilization in different fishing sectors. For halibut and other PSC and bycatch species, conduct research to better identify where regulations restrict the utilization of fish from its most beneficial use and evaluate how changes in existing regulations would affect different sectors and fisheries. (partially underway)

6. Initiate/continue research on developing and evaluating thresholds for ecosystem indicators, including ecosystem-level management strategy evaluation.

II. Fisheries Interactions

A. Protected species

1. Studies of the localized interactions between fisheries and protected species, such as interactions between Steller sea lions and commercial fish species in the Central and Western Aleutian Islands (particularly areas 541, 542, 543), are needed. These studies should be conducted at appropriate spatial and temporal scales with an emphasis on seasonal prey fields, diet, and movement of sea lions and their prey.

2. Assess age- and size-specific vital rates (i.e., reproduction and survival) of Steller sea lions in the western and central Aleutians at sufficient frequency to track population dynamics in the western DPS.

3. Assess possible indirect effects of fisheries removals via periodic health assessments, indices of body condition, survival of pups and juveniles, and pup-non pup ratios of Steller sea lions in the eastern DPS.

4. Quantify killer whale predation of Steller sea lions, particularly in the western and central Aleutian Islands.

5. Develop new methods to estimate sea lion abundance, such as the use of unmanned aerial vehicles, which could increase the probability of acquiring abundance estimates in remote areas. (underway)

6. Assess the impact of the displacement of the groundfish fleet due to Steller sea lions protection measures on the prey availability, foraging ecology, diet, movements, and vital rates for Northern fur seals (partially underway).

7. Assess the extent and impact of seabird incidental takes in fisheries on bird populations, and develop methods to reduce seabird incidental takes, particularly of protected species, such as short-tailed albatross.

8. Determine potential impacts of fishing activities on North Pacific right whales and the Eastern North Pacific blue whales in the GOA, particularly in identified critical (NPRW) or essential (NPBW) habitat.

III. Habitats

A. Evaluate habitats of particular concern:

1. Assess whether Bering Sea canyons are habitats of particular concern, by assessing the distribution and prevalence of coral and sponge habitat, and comparing marine communities within and above the canyon areas, including mid-level and apex predators to neighboring shelf/slope ecosystems. (partially underway)

B. Baseline Habitat Assessment

1. Dynamic ecosystem and environmental changes in the northern Bering Sea and Arctic are occurring on a pace not observed in recorded time. In response to the new Arctic FMP, assessment of the current baseline conditions and trophic interactions is imperative. This effort, while of great scientific importance, should not supplant the regular surveys in the BSAI and GOA, which are of critical importance to science and management. (partially underway)

C. Fishing Effects on Habitat

1. Research is needed on the effects of trawling on the distribution of breeding and ovigerous female red king crab and subsequent recruitment. Relevant studies include effects of potential habitat modifications on the distribution of females, particularly in near-shore areas of southwest Bristol Bay (partially underway), and environmental effects (e.g., trawling overlap in warm vs. cold years). Retrospective studies, the use of pop-up tags to identify larval release locations, and larval advection using Regional Ocean Modeling System would help address this need.

2. Impact of bottom trawl fisheries on invertebrate abundance and species composition in benthic habitats, especially as might be relevant to the foraging ecology of walrus (candidate species for listing under ESA), but also bearded seals (ESA determination due in July), and gray whales.

**Ongoing Needs**

I. Fisheries

A. Fish and Fishery Monitoring

1. Continuation of State and Federal annual and biennial surveys in the GOA, AI, and EBS, including BASIS surveys and crab pot surveys, is a critical aspect of fishery management off Alaska. It is important to give priority to these surveys, in light of recent federal budgets in which funding may not be sufficient to conduct these surveys. Loss of funding for days at sea for NOAA ships jeopardizes these programs. These surveys provide baseline distribution, abundance, and life history data that form the foundation for stock assessments and the development of ecosystem approaches to management. ***Although an ongoing need, these surveys are considered the highest priority research activity, contributing to assessment of commercial groundfish and crab fisheries off Alaska.***

2. Conduct routine subsistence use, fish, crab, and oceanographic surveys of the northern Bering Sea and Arctic Ocean. These surveys will become increasingly important under ongoing warming ocean temperatures because range expansions of harvested fishery resources may occur. If range expansions or shifts occur, data will be needed to adjust standard survey time series for availability.

3. Explore alternative approaches to the triennial ADF&G Aleutian Islands golden king crab pot survey to acquire fishery-independent abundance data on stock distribution and recruitment, including the potential for future cooperative research efforts with industry.

4. Continue and expand cooperative research efforts to supplement existing surveys to provide seasonal or species-specific information for use in improved assessment and management. The SSC places a high priority on studies that provide data to assess seasonal diets and movements of fish and shellfish, for use in studies of species interactions in spatially explicit stock assessments.

5. The HAPC action for skate egg case concentration sites included two recommendations that the Council suggested should be addressed during the annual research priority discussion: (a) skate egg case concentrations should be monitored every 2 to 3 years using non-invasive research design, such as in situ observation; and (b) skate conservation and skate egg concentration areas remain a priority for EFH and HAPC management and within Council and NMFS research plans.

6. For groundfish in general, and rockfish in particular, continue and expand research on trawlable and untrawlable habitat to improve resource assessment surveys. For example, improved surveys, such as hydro-acoustic surveys, are needed to better assess pelagic rockfish species that are found in untrawlable habitat or are semi-pelagic species, such as northern and dusky rockfish.

7. Studies are needed to evaluate effects of the environment on survey catchability. For groundfish and crabs, studies are needed on catchability, as it directly bears on estimates of the stock size for setting of catch quotas. Research to refine the estimates of survey catchability, q, used to infer absolute, rather than relative, abundance would substantially improve the quality of management advice. Particular emphasis should be placed on Tanner crab, because of recent trends in stock status, and on fishery and fishing gear selectivity for Aleutian Island golden king crab to improve the stock assessment model.

8. Continue research on the design and implementation of appropriate survey analysis techniques, to aid the Council in assessing species (e.g., some crabs and rockfish) that exhibit patchy distributions and, thus, may not be adequately represented (either over- or under-estimated) in the annual or biennial groundfish surveys.

9. Advance research towards developing a quantitative female reproductive index for the surveyed BSAI crab stocks. Research is needed on mating, fecundity, fertilization rates, and, for snow and Tanner crab, sperm reserves and biennial spawning, to develop annual indices of fertilized egg production that can be incorporated into the stock assessment process and to model the effects of sex ratios, stock distribution, and environmental change on stock productivity. Priority stocks for study are eastern Being Sea snow and Tanner crab and Bristol Bay red king crab. (Ongoing for snow crab and red king crab)

10. Expand existing efforts to collect maturity scans during fisheries that target spawning fish (e.g., pollock). Time series of maturity at age should be collected to facilitate the assessment of the effects of density-dependence and environmental conditions on maturity.

11. Identification and recovery of archived data (e.g., historical agency groundfish and shellfish surveys) should be pursued. Investigate integrating these data into stock and ecosystem assessments.

12. There is a need for fishery-independent surveys of scallops on major fishing grounds, e.g., Yakutat, other areas.

13. Develop a long-term survey capability for forage fish (partially underway).

C. Stock Assessment

1. Acquire basic life history information needed for stock assessment and bycatch/PSC management of data-poor stocks, such as scallops, sharks, skates, sculpins, octopus, grenadiers, squid, and blue king crab (Bering Sea), golden king crabs (Aleutian Islands), and red king crab (Norton Sound). Specifically, information is needed on natural mortality, growth, size at maturity, and other basic indicators of stock production/productivity). For octopus, there is particular need for estimates of mortality and abundance, including verification of the cod consumption-based approach. Tagging studies would provide information on growth and movement of scallops and growth and absolute abundance estimates for golden king crab.

2. Improve estimates of natural mortality (M) for several stocks, including Pacific cod and BSAI crab stocks. **Develop and validate aging methods for crabs to improve estimates of M, including improved independent estimates of stage-specific M (e.g., large red king crab in Norton Sound).**

3. Studies are needed to validate and improve age determination methods for Pacific cod, Pacific sleeper sharks, and spiny dogfish. (partially underway for Pacific cod and spiny dogfish)

4. Evaluate the assessment and management implications of hybridization of snow and Tanner crabs.

5. Quantify the effects of historical climate variability and climate change on recruitment and growth, and develop standard environmental scenarios for present and future variability based on observed patterns. There is also a clear need for information that covers a wider range of seasons than is presently available.

6. There is a need for the development of projection models to evaluate the performance of different management strategies relative to the Council's goals for ecosystem approaches to management. Projection models are also needed to forecast seasonal and climate related shifts in the spatial distribution and abundance of commercial fish and shellfish. (partially underway)

7. To identify stock boundaries, expanded studies are needed in the areas of genetics, mark-recapture, reproductive biology, larval distribution, and advection.

8. Develop spatially explicit stock assessment models, where appropriate. High priority species for spatially explicit models include: snow crab, walleye pollock, Pacific cod, sablefish, yellowfin sole,

rock sole, arrowtooth flounder, Pacific ocean perch, black spotted rockfish, rougheye rockfish, and Atka mackerel. (partially underway for some species )

9. Genetic studies to provide information on sources and sinks for scallop larvae are needed to improve our understanding of the rate of larval exchange between scallop beds. Age-structured models for scallop assessment are also needed.

10. Conduct multivariate analysis of bycatch data from the scallop observer program (haul composition data) to estimate abundance and trends of benthic communities on scallop beds and computerized image processing to facilitate scallop stock assessments from camera sled (CamSled) data.

D. Fishery Management

1. Refine methods to incorporate uncertainty into harvest strategies for groundfish for ACL estimation. Continue existing management strategy evaluations at the stock level. (underway)

2. Conduct studies documenting the subsistence harvest patterns, norms, and quantities in communities that depend upon resources that may be affected by Council action.

3. Examine interactions between coastal communities and commercial fisheries (e.g., subsistence-commercial linkages, adaptations to changes in resource use, economic opportunities for coastal communities).

4. Evaluate the effectiveness (e.g., potential for overharvest or unnecessarily limiting other fisheries) of setting ABC and OFL levels for data-poor stocks (Tier 5 and 6 for groundfish and Tiers 4 and 5 for crab, e.g., squid, octopus, shark, sculpins, other flatfish, other rockfish, skates, grenadier, and crab). Research is needed to refine the basis for setting gamma for Tier 4 crab stocks. (partially underway)

5. Conduct retrospective analyses to assess the impact of Chinook salmon PSC measures on the BSAI pollock fishery. Analyses should include an evaluation of the magnitude and distribution of economic effects of salmon avoidance measures for the Bering Sea pollock fishery. In this case, it is important to understand how pollock harvesters have adapted their behavior to avoid Chinook and "other" salmon, under various economic and environmental conditions and incentive mechanisms.

6. Develop forecasting tools that incorporate ecosystem indicators into single or multispecies stock assessments, to conduct management strategy evaluations under differing assumptions regarding climate and market demands. Standardization of "future scenarios" will help to promote comparability of model outputs.

7. Development of an ongoing database of product inventories (and trade volume and prices) for principal shellfish, groundfish, Pacific halibut, and salmon harvested by U.S. fisheries in the North Pacific and eastern Bering Sea.

8. Analyze current determinants of ex vessel, wholesale, international, and retail demand for principal seafood products from the GOA and BSAI.

9. Conduct pre- and post-implementation studies of the benefits and costs, and their distribution, associated with changes in management regimes (e.g., changes in product markets, characteristics of quota share markets, changes in distribution of ownership, changes in crew compensation) as a consequence of the introduction of dedicated access privileges in the halibut/sablefish, AFA pollock, and BSAI crab fisheries. "Benefits and costs" include both economic and social dimensions.

10. Conduct prospective analyses of the robustness and resilience of alternative management strategies under varying environmental and ecological conditions.

11. Conduct prospective and retrospective analyses of changes in the spatial and temporal distribution of fishing effort, in response to management actions (e.g., time/area closures, marine reserves, PSC and other bycatch restrictions, co-ops, IFQs).

12. Develop a framework for collection of economic information on commercial, recreational, and charter fishing, as well as fish processing, to meet the requirements of the MSFCMA sections 303(a)(5, 9, 13), 303(b)(6), and 303A.

13. Continue to evaluate the economic effects from crab rationalization programs on coastal communities. This includes understanding economic impacts (both direct and indirect) and how the impacts are distributed among communities and economic sectors.

14. Improve estimation of fishery interactions (including catch) with marine mammals (e.g., state managed gillnet fisheries), seabirds, and non-target groundfish (e.g., sharks, skates), and protected species.

II. Fisheries Interactions

A. Protected Species Interactions

1. Economic, social, and cultural valuation research on protected species (i.e., non-market consumptive use, passive use, non-consumptive use), particularly in the Arctic.

2. Foraging ecology and vital rate studies of Steller sea lions in the Gulf of Alaska, Russian Far East, and Commander Islands, including at-sea tracking of older animals, and diet composition of sea lions throughout the region. Emphasis should be placed on the use of methods that allow population abundance estimates to be directly compared between Russia and Alaska.

3. Linkages between fishery-induced disturbance or local prey depletion for northern fur seals in the Pribilof Islands region. (underway)

4. Gear modifications and fishing practices to reduce bycatch and, particularly, PSC (e.g., salmon and crab). (partly underway)

5. Studies of sperm whale depredation of catch in long-line fisheries and surveys to improve the quality of long-line fish abundance estimates. (underway)

6. Monitor interactions between fishing fleet and protected seabirds, particularly, in Aleutian Islands and the eastern Bering Sea shelf edge where numbers of albatross have increased.

7. Assess the potential for increased interactions between protected species (i.e., large whales and post-breeding/migrating seabirds) and fishing efforts in essential habitats, in particular throughout migratory routes, and with respect to changes in fish stock distribution and/or expansion into Arctic waters.

B. Bycatch/PSC Issues

1. There is a need to analyze the effects of recent Council actions on bycatch and PSC, including:
    a. interaction among PSC reduction initiatives (e.g., halibut, salmon)
    b. quantifying the effects of PSC reduction in groundfish fisheries to the target fisheries (e.g., charter and commercial halibut fisheries, salmon fisheries)
    c. Research approaches to create bycatch and PSC reduction incentives.

III. Habitat

A. Habitat Mapping

1. Improved habitat maps (especially benthic habitats) are required to identify essential fish habitat and distributions of various substrates and habitat types, including habitat-forming biota, infauna, and epifauna in the GOA, BS, and Arctic. (partially underway)

2. Develop a GIS relational database for habitat, including development of a historical time series of the spatial intensity of interactions between commercial fisheries and habitat. Such time series are needed to evaluate the impacts of changes in fishing effort and type on EFH. Assess the extent of the distribution of *Primnoa* corals and skate egg case concentration sites in the GOA, and conduct routine monitoring of these areas.

B. Function of Habitat

1. Research is needed on the role of habitat in fish population dynamics, fish production (growth, reproduction), and ecosystem processes. Such research will improve the capability to identify and protect important habitats (including essential fish habitat and habitat areas of particular concern); help design effective habitat restoration efforts; improve the design and management of marine protected areas; improve fishery-independent population surveys; and improve stock assessments. Studies are needed to evaluate relationships between, and functional importance of, habitat-forming living substrates to juvenile and adult age classes of commercially important species and their preferred prey (forage fish). (partially ongoing)

2. Establish a scientific research and monitoring program to understand the degree to which impacts (habitat, benthic infauna, etc.) have been reduced within habitat closure areas, and to understand how benthic habitat recovery of key species is occurring. (This the objective of the EFH research approach for the Council FMPs).

IV. Other Areas of Research Necessary for Management

A. Ecosystem indicator development and maintenance.

1. Climatic indicators

a) Develop a multivariate index of the climate forcing of the Bering Sea shelf. Three biologically significant avenues for climate index predictions include advection, setup for primary production, and partitioning of habitat with oceanographic fronts and temperature preferences.
b) Develop bottom and water column temperature database for use in EBS, GOA, and AI stock assessments.
c) Maintain sea ice formation and retreat index for the EBS.

2. Lower trophic level community production data

a. Collect and maintain primary production time series in the EBS, AI, GOA, and Arctic; particularly in relationship to key climate and oceanographic variables.
b. Collect and maintain zooplankton biomass and community composition time series in the eastern Bering Sea. Develop, collect, and maintain time series of zooplankton biomass and community composition for the GOA, AI, and Arctic.
c. Collect and maintain data on forage fish community composition and abundance in the Bering Sea, GOA, AI, and Arctic.
d. Collect and maintain time-series data on the community composition, production and biomass of benthic invertebrate and vertebrate fauna.

3. Develop methods for incorporating ecosystem indicators into stock assessments and ecosystem assessments. Specifically:

a. Maintain indicator-based ecosystem assessment for EBS.
b. Develop indicator-based ecosystem assessments for AI (in progress), GOA, and Arctic.
c. Develop stock-specific ecosystem indicators and incorporate into stock assessments. (in progress)

4. Develop methodologies to monitor for new/emerging diseases among exploited species and higher trophic levels.

5. Assess the impact of increases in recovering whale populations (e.g. gray, humpback, and fin) on lower trophic level energy pathways.

6. Ecosystem indicator synthesis research.

7. Continue and expand cooperative research efforts to supplement existing at-sea surveys that provide seasonal, species-specific information on upper trophic levels (seabirds and marine mammals). Updated surveys to monitor distribution and abundance of seabirds and marine mammals are needed to assess impacts of fisheries on apex predators, improve the usefulness of apex predators as ecosystem indicators, and to improve ecosystem management.

8. Initiate and expand non-market valuation research of habitat, ecosystem services, and passive use considerations.

9. Assess the relative importance of non-commercially exploited species (invertebrates, fish, marine mammals, and seabirds) to human communities, particularly in Arctic.

B. Research on Environmental Influences on Ecosystem Processes

1. Climate variability: monitor and understand how changes in ocean conditions influence managed species.

a) Maintain moorings. Development and maintenance of indices of the timing and extent of the spring bloom is a high priority. For this, maintenance of moorings, especially M-2, is essential. (underway)

b) Monitor seasonal sea ice extent and thickness: If recent changes in ice cover and temperatures in the Bering Sea persist, these may have profound effects on marine communities.

c) Measure and monitor fish composition: Evaluate existing data sets (bottom trawl surveys, acoustic trawl surveys, and BASIS surveys) to quantify changes in relative species composition of commercial and non-commercial species, identify and map assemblages, and monitor changes in the distribution of individual species and assemblages. Additional monitoring may be necessary in the Aleutian Islands, northern Bering Sea, and areas of the Gulf of Alaska.

d) Assess the movement of fish to understand the spatial importance of predator-prey interactions in response to environmental variability.

2. Improve understanding of ocean acidification and its effects on managed species

a) Collect and maintain time series of ocean pH in the major water masses off Alaska. (partially underway)

b) Assess whether changes in pH would affect managed species, upper level predators, and lower trophic levels. (partially underway for some species)

3. Species' responses to multiple environmental stressors

a) Laboratory studies are needed to assess the synergistic effects of ocean acidification, oil, dispersants, and changes in temperature on productivity of marine species.
b) Monitor contaminant flux and loads in lower and higher trophic levels, and assess potential for impact on vital rates.

C. Basic research on trophic interactions

1. Collect, analyze, and monitor diet information (species, biomass, energetics), from seasons in addition to summer, to assess spatial and temporal changes in predator-prey interactions, including marine mammals and seabirds. The diet information should be collected on the appropriate spatial scales for key predators and prey to determine how food webs may be changing in response to shifts in the range of crab and groundfish.

2. Ecosystem structure studies: Studies are needed on the implications of food web interactions of global warming, ocean acidification, and selective fishing. For instance, studies are needed to evaluate differential exploitation of some components of the ecosystem (e.g., Pacific cod, pollock, and crab) relative to others (e.g., arrowtooth flounder).

3. In the last decade, many whale populations (e.g., gray, humpback, and fin) have increased dramatically, after being depleted by whaling. These increases in abundance have the potential to alter lower trophic level energy pathways in the region. In addition, we should investigate potential impacts to other upper trophic level groups (i.e., pinnipeds, seabirds, large predatory fish).

D. Ecosystem Modeling

1. Modeling studies of ecosystem productivity in different regions (EBS, GOA and AI).